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(54) Combination catalytic converter and filter

(57) A combination catalytic converter and filter (10) for internal combustion engine exhaust is provided by a single unitary flow member having an upstream frontside (14) and a downstream backside (16). The member has a plurality of flow channels (18) extending axially from the upstream frontside to the downstream backside. Each channel has left and right sidewalls (20 and 22) formed by pleated filter media (24), and top and bottom walls formed by respective upper and lower boundary layers (26 and 28). The left and right sidewalls (20 and 22) extend axially continuously from the upstream frontside to the downstream backside. The sidewalls (20 and 22) have first upstream sections (30, 32) proximate the upstream frontside (14), and second downstream sections (34, 36) proximate the downstream backside (16). One of the sections is a catalytic section (33) treated with a catalyst for the exhaust. The other of the sections is a filter section (35) having axially spaced alternately blocking sealants (38, 40) in alternate channels (48, 44) such that exhaust must pass through the pleated filter media (24). The catalytic section may be upstream or downstream of the filter section. A filter section may be nested axially between two catalytic sections, as well as other combinations and sequencing. The filter section may additionally be treated with catalyst.

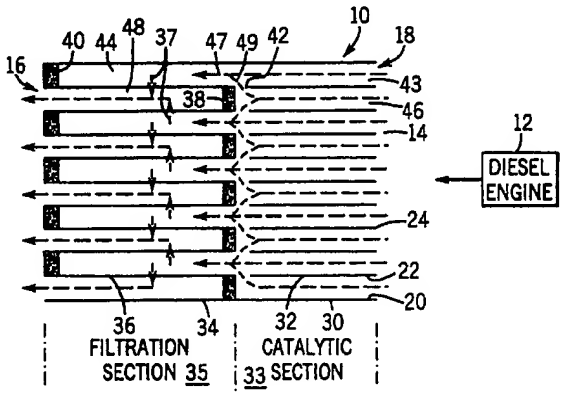

FIG. 2

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Des ripti n

[0001] The invention relates to exhaust emission devices for internal combustion engines, including diesel engines, and more particularly to catalytic converters and to filters.

[0002] Various diesel exhaust aftertreatment systems require that the exhaust be directed through a catalytic component and also through a filter component to achieve emissions and/or particulate (e.g. soot) reduction. The present invention provides a simple system combining these devices in a singular unit. In a desirable aspect, the invention further maintains exact axial alignment of catalytic and filter flow channels and simplifies packaging.

Description of the Drawings:

[0003]

Fig. 1 is an exploded perspective view of a combination catalytic converter and filter in accordance with the invention.

Fig. 2 Is a sectional view from above of the device of Fig. 1.

Fig. 3 is a view like Fig. 2 and shows another embodiment.

Fig. 4 is a view like Fig. 2 and shows another embodiment.

Detailed Description:

[0004] Figs. 1 and 2 show a combination catalytic converter and filter 10 for an internal combustion engine such as diesel engine 12. The combination catalytic converter and filter is provided by a single unitary flow member having an upstream frontside 14 and a downstream backside 16. Member 10 has a plurality of flow channels 18 extending axially from upstream frontside 14 to downstream backside 16. Each channel has left and right sidewalls such as 20 and 22 formed by pleated filter media 24, and top and bottom walls formed by respective upper and lower boundary layers 26 and 28. Left and right sidewalls 20 and 22 extend axially continuously from upstream frontside 14 to downstream backside 16. The sidewalls have upstream sections 30, 32, etc. proximate frontside 14, and downstream sections 34, 36, etc. proximate backside 16. Upstream sections 30, 32, etc. provide a catalytic section 33 treated with a catalyst for the exhaust. Downstream sections 34, 36, etc. provide a filter section 35 and have axially spaced alternately blocking sealants 38, 40, etc. in alternate channels such that exhaust flow must pass through pleated filter media 24 in filt r section 35, as shown at arrows such as 37. Each of left and right sidewalls 20, 22, tc. xtends axially rectilin arly from catalytic section 33 to filter section 35, maintaining exact axial alignment of the respectiv channels including the catalyzing and filtering sections thereof. Pleated filter media 24 is a continuous sheet spanning both catalytic section 33 and filter section 35.

[0005] In one preferred embodiment, catalytic section 33 is upstream of filter section 35. A first set of alternating blocking sealants 38, etc. are at the upstream ends of respective channels in filter section 35, and a second set of alternating blocking sealants 40, etc. are at downstream ends of respective channels in filter section 35. In this embodiment, it is preferred that the sidewalls of the channels of catalytic section 33 are perforated as shown at 42 such that exhaust flows through catalytic section 33 along a first set of alternate channels such as 43 rectilinearly aligned with a first set of alternate channels such as 44 in filter section 35, and exhaust also flows through catalytic section 33 along a second set of alternate channels such as 46 laterally offset from first set of channels 43 and communicating therewith through the perforations 42, such that exhaust flows through all of the channels of catalytic section 33 notwithstanding the noted alternating blocking sealants 38, 40 in filter section 35. Exhaust flow through all of the channels of catalytic section 33 is desirable to increase surface area for catalytic activity. In this embodiment, the noted first set of alternate channels 43 in catalytic section 33 are open at their downstream ends 47, and exhaust flows rectilinearly from such first set of channels 43 in catalytic section 33 to first set of alternate channels 44 in filter section 35. The downstream ends of the first set of channels 44 in filter section 35 are blocked by the noted second set of alternating blocking sealants 40. The noted second set of alternate channels 46 in catalytic section 33 are blocked at their downstream end by the noted first set of alternating blocking sealants 38 in the upstream ends of second set of alternate channels 48 in filter section 35. Perforations 42 are upstream of the noted first set of alternating blocking sealants 38, such that exhaust flows axially along the noted second set of channels 46 in catalytic section 33 and then laterally through perforations 42 as shown in dashed line at arrows such as 49 in Fig. 2 and joins the flow in the first set of channels 43 in catalytic section 33 flowing axially rectilinearly into the noted first set of channels 44 in filter section 35. Sealant is applied along the upper pleat tips as shown at 39 downstream of perforations 42, to seal the upper tips of pleated filter media 24 to upper boundary layer 26. Sealant is applied along the lower pleat tips as shown at 41 downstream of perforations 42, to seal the lower tips of pleated filter media 24 to lower boundary layer 28.

[0006] In another embodiment, the catalytic section may be downstream of the filter section, as shown in Fig. 3 at upstream filter section 52 and downstream catalytic section 54. In a further embodim nt, a s cond catalytic section may be add d to the configuration of Fig.

2 downstream of the filter section, such that a filter section is nested between two catalytic sections, i. . catalyst/filter/catalyst, for example as shown in Fig. 4 at upstream catalytic section 56, downstream filter section 58 and further downstream catalytic section 60. In another embodiment, the filter section of the unitary member is treated with a catalyst. For example, in Fig. 2, filter section 35 is further treated with a catalyst to oxide soot or collected contaminant, while the catalytic treatment in catalytic section 33 reduces or acts upon another gaseous portion of the exhaust. Thus, the device is provided with different catalytic treatments at different sections so that separate functions occur. In further embodiments, filter sections 52, Fig. 3 and 58, Fig. 4, may also be provided with catalytic treatment. Other combinations and sequencing are possible.

[0007] In preferred form, the device of Fig. 1 is wrapped in a spiral, for example as shown in U.S. Patents 4,652,286 and 5,908,480, incorporated herein by reference, to provide a multilayered structure. In such embodiment, one of the upper or lower boundary layers 26 or 28 may be eliminated, because in a spiral wrap the remaining layer provides the boundary for the channels on opposite sides thereof. Boundary layers 25 26 and/or 28 may be formed of a sheet of filter media or may be impervious to the exhaust flow. Boundary layers 26 and/or 28 may be perforated as shown at 50 and 52 which perforations are laterally aligned with perforations 42. In another embodiment, the single row of channels in Fig. 1 may be stacked, for example as shown in incorporated U.S. Patent 4,652,286, to provide a plurality of rows and columns of channels. In such stacked structure one of the boundary layers 26 or 28 may be eliminated because the remaining layer will provide a boundary layer for the channels on opposite sides thereof, e. g. if top layer 26 is omitted, then layer 28 of the second row of channels will provide the bottom wall for such second row of channels and will provide the top wall for the first row of channels therebelow.

[0008] It is recognized that various equivalents, alternatives and modifications are 5 possible within the scope of the appended claims.

Claims

1. A combination catalytic converter and filter (10) for internal combustion engine exhaust comprising in a single unitary member pleated filter media (24) defining a plurality of axially extending flow channels (18) having first and second serially sequential axial sections (33, 35), one of said first and second sections being a catalytic section (33) treated with a catalyst for said exhaust, the other of said first and second sections being a filter section (35) with alternately sealed channels (43, 44, 46, 48) forcing exhaust to flow through said pleated filter media (24), and wherein, optionally, said pleated filter media (24) is a continuous she t spanning both of said first and second sections (33, 35).

2. Structure according to claim 1 wherein said catalytic section (33) is upstream of said filter section (35), or wherein said filter section (52) is upstream of said catalytic section (54).

3. Structure according to claim 1 or 2 further comprising in combination a third serially sequential axial section (60), said second section (58) being nested between said first and third sections (56, 60) in axial alignment therewith, and wherein, preferably, said first and third sections (56, 60) are catalytic sections, and said second section (58) is a filter section.

4. Structure according to any one of the claims 1 to 3 wherein said filter section (35) is formed between axially spaced first and second sets of alternating blocking sealants (38, 40) in said channels (43,44,46,48) such that exhaust flow (37) must pass through said pleated filter media (24) from one channel to an adjacent channel in said filter section (35), and wherein, preferably, said first section is said catalytic section (33), said second section is said filter section (35), said first section is upstream of said second section, said first set of alternating blocking sealants (38) is at the upstream end of said filter section (35), said second set of alternating blocking sealants (40) is at the downstream end of said filter section (35).

5. A combination catalytic converter and filter (10) for internal combustion engine exhaust comprising a single unitary flow member having an upstream side (14) and a downstream side (16), said member having a plurality of flow channels (18) extending axially from said upstream side (14) to said downstream side (16), each channel having left and right sidewalls (20, 22) formed by pleated filter media (24), and top and bottom walls formed by respective upper and lower boundary layers (26, 28), said left and right sidewalls (20, 22) extending axially continuously from said upstream side (14) to said downstream side (16), said sidewalls (20, 22) having first upstream sections (30, 32) proximate said upstream side (14), said sidewalls (20, 22) having second downstream sections (34, 36) proximate said downstream side (16), one of said first and second sections being a catalytic section (33) treated with a catalyst for said exhaust, the other of said first and second sections being a filter section (35) and having axially spaced alternately blocking sealants (38, 40) in alternate channels (43,44,46,48) such that exhaust must flow through said pleated filter media (24), and wherein, optionally, each of said left and right sidewalls (20, 22) of each channel extends axially rectilinearly from said first section

(33) to said second section, (35) maintaining exact axial alignment of the respective said channel including the catalyzing and filtering sections (33, 35) thereof.

6. Structure according the claim 5 wherein said sidewalls (20, 22) of said catalytic section (33) are perforated such that exhaust flows through said catalytic section (33) along a first set of alternate channels (43) axially rectilinearly aligned with a first set of alternate channels (44) in said filter section (35), and exhaust flows through said catalytic section (33) along a second set of alternate channels (46) laterally offset from said first set of channels (43, 44) and communicating therewith through said perforations, (42) such that exhaust flows through all of the channels (43, 46,) of said catalytic section (33), increasing surface area for catalytic activity, notwithstanding said alternating blocking sealants (38, 40) in said filter section (35).

7. Structure according to claim 6 wherein:

said catalytic section (33) is axially upstream of said filter section (35);

said axially spaced alternating blocking sealants (38, 40) comprise a first set of alternating blocking sealants (38) at the upstream end of said filter section (35) and a second set of alternating blocking sealants (40) at the downstream end of said filter section (35);

said first set of alternate channels (43) in said catalytic section (33) are open at their downstream ends, and exhaust flows rectilinearly from said first set of channels (43) in said catalytic section (33) to said first set of channels (44) in said filter section (35), the downstream ends of said first set of channels (44) in said filter section (35) being blocked by said second set of said alternating blocking sealants (40);

said second set of alternate channels (46) in said catalytic section (33) are blocked at their downstream end by said first set of said alternating blocking sealants (38) in the upstream ends of a second set of alternate channels (48) in said filter section (35);

said perforations (42) are upstream of said first set of alternating blocking sealants (38, 40), such that exhaust flows axially along said second set of channels (46) in said catalytic section (33) and then laterally through said perforations (42) and joins said flow in said first set of channels (43) in said catalytic section (33) flowing axially rectilinearly into said first set of channels (44) in said filter section (35).

8. Structure according to claim 6 wherein:

said filter section (52) is axially upstream of said catalytic section (54);

said axially spaced alternating blocking sealants (38, 40) comprise a first set of alternating blocking sealants at the upstream end of said filter section (52) and a second set of alternating blocking sealants at the downstream end of said filter section (52);

said first set of alternate channels (43) in said catalytic section (54) are open at their upstream ends, and exhaust flows rectilinearly from said first set of channels (44) in said filter section (52) to said first set of channels (43) in said catalytic section (54), the upstream ends of said first set of channels (44) in said filter section (52) being blocked by said first set of said alternating blocking sealants;

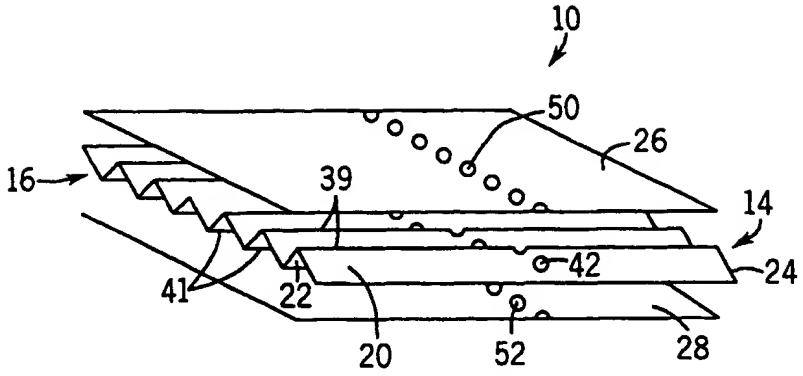
said second set of alternate channels (46) in said catalytic section (54) are blocked at their upstream end by said second set of alternating blocking sealants in the downstream ends of said second set of alternate channels (48) in said filter section (52);

said perforations (42) are downstream of said second set of alternating blocking sealants, such that exhaust flows axially along said first set of channels (44) in said filter section (52) and then some of the exhaust flows laterally through said perforations (42) and then flows axially rectilinearly along said second set of channels (46) in said catalytic section (54).

9. Structure according to claim 5, wherein said sidewalls (20, 22) have third downstream sections (60) downstream of said second sections (58), said second sections (58) being nested between in axial alignment with said first and third sections (56, 60), each of said left and right sidewalls (20, 22) of each channel extending axially rectilinearly from said first section (56) to said second section (58) to said third section (60), maintaining exact axial alignment of the respective said channel, and wherein, preferably, said first and third sections (56, 60) are catalytic sections, and said second section (58) is a filter section and further wherein, optionally, said sidewalls (20, 22) of said first and third catalytic sections (56, 60) are perforated such that exhaust flows through said first catalytic section (56) along a first set of alternate channels (43) axially rectilinearly aligned with a first set of alternate channels (44) in said sec-

ond filter section (58), and xhaust flows through said first catalytic section (56) along a second set of alternate channels (46) laterally offset from said first set of channels (44) and communicating therewith through said perforations (42), such that exhaust flows through all of the channels (43, 46) of said first catalytic section (56), increasing surface area for catalytic activity, notwithstanding said alternating blocking sealants (38, 40) in said second filter section (58), and exhaust flows from a second set of alternate channels (48) in said second filter section (58) rectilinearly aligned with a first set of alternate channels (43) in said third catalytic section (60), and exhaust also flows from said second set of channels (48) in said second filter section (58) through said perforations (50, 52) in said sidewalls (20, 22) of said third catalytic section (60) and then axially along a second set of alternate channels (46) in said third catalytic section (60), such that exhaust flows through all of the channels (43, 46) in said third catalytic section (60), increasing surface area for catalytic activity, notwithstanding said alternating blocking sealants (38, 40) in said second filter section (58).

10. Structure according to any one of the preceding claims wherein said filter section (35, 52, 58) is treated with catalyst.


10
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26
16
39
14
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24
41
22
20
52
28

FIG. 1

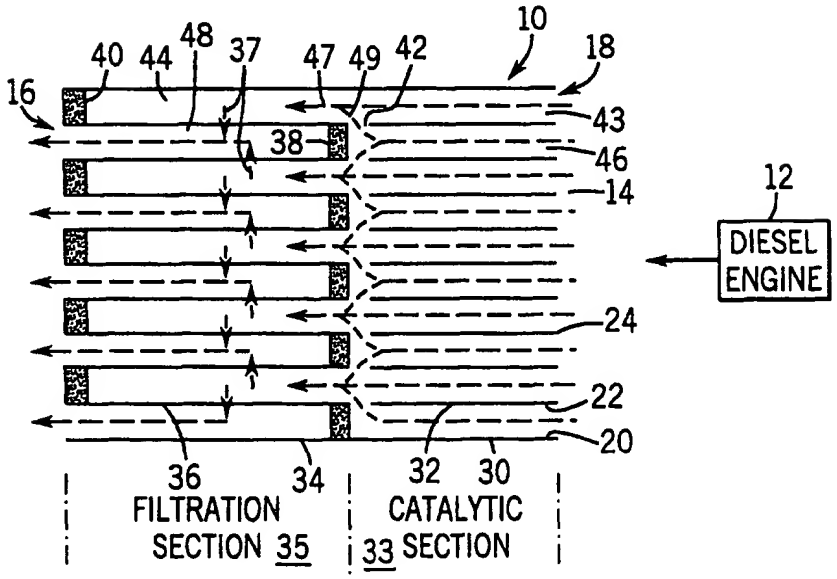
10
40
44
48
37
47
49
42
18
16
43
38
46
14
12
DIESEL ENGINE
24
22
20
36
34
32
30
FILTRATION SECTION 35
33 SECTION
CATALYTIC

FIG. 2

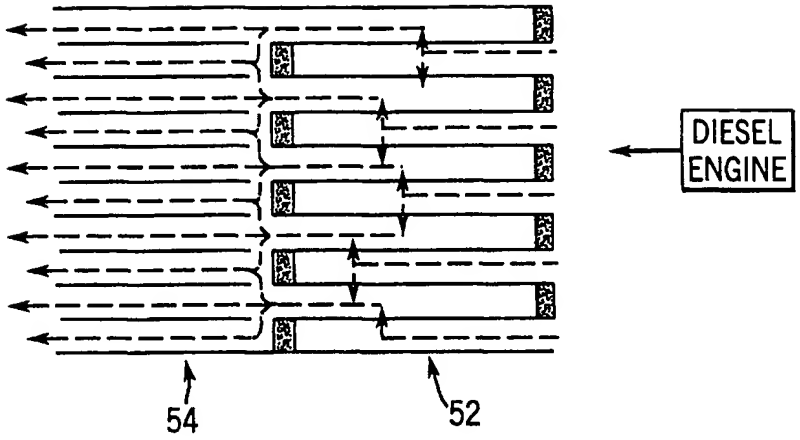

FIG. 3

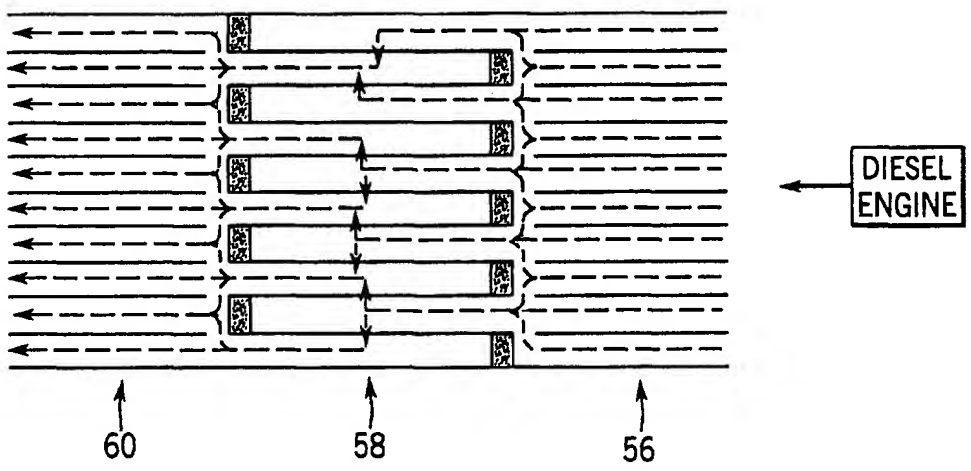

FIG. 4